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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/249,292	02/12/1999	TETSUO ONO	503.36911CX1	9771

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EXAMINER

OLSEN, ALLAN W

ART UNIT	PAPER NUMBER
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1763

DATE MAILED: 08/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application N .

09/249,292

Applicant(s)

ONO ET AL.

Examiner

Allan W. Olsen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11 June 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,4 and 30-33 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,4 and 30-33 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All   b) ☐ Some \*   c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Objections*

Claim 33 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 33 requires that that no rf bias voltage be applied while the rf bias is in the off state. The Examiner does not see how this further limits claim 1 as by definition, when the rf bias is off there can be no application of an rf bias voltage.

### *Claim Rejections - 35 USC § 112*

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

**Claim 4 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

Claim 4 recites "wherein the duty ratio when the rf bias voltage is in the on state is set to 5 to 50%" (emphasis added). However, the phrase "duty ratio" is used to indicate what the percentage of the total time that a bias power is on. As such, when the rf bias is in the on state the duty ratio, by definition, is 100%.

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***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**Claims 1, 4 and 30-33 and are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. 5,352,324 issued to Gotoh et al (hereinafter, Gotoh).**

Gotoh teaches a method of etching a substrate. Gotoh's method includes applying a RF bias with a frequency of 1 kHz or more to the substrate support (column 8, line 12). Gotoh teaches applying a high frequency RF bias to the substrate support (column 8, lines 25-26). The examiner takes official notice that a high rf frequency is at least the claimed 100 kHz, with the most commonly used high frequency being the FCC mandated 13.56 MHz. Note for example the following categorization (as found at <http://www.mksinstr.com/enirf.html>): Low-Frequency RF Generators operate between 90 kHz and 1 MHz; Mid-Frequency RF Generators operate between 1 and 4 MHz; High-Frequency RF Generators, 13.56 MHz is the frequency most commonly used for plasma processes. Gotoh teaches that the power supply for the high frequency bias is controlled independently from the power supply that is used for generating the plasma. Gotoh method includes providing the RF biasing power intermittently or on-off modulating the RF bias power. Gotoh teaches modulating with a duty ratio of between 2% and 50% (figures 5 and 6; column 9, lines 23-25). Gotoh teaches etching a multi-layered substrate wherein during the initial etching phase a second layer, which underlies a first layer, is not initially exposed. Claim 1 requires the on-off modulation of the bias power in a first period etching wherein the etching selectivity in the first period is less than the etching selectivity during a subsequent etching period. Whereas the etching selectivity modulates inversely with the modulation of the bias power (i.e. high bias/low selectivity), during each on-off cycle there is

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a period of relative low selectivity (i.e., bias on), which is followed in a subsequent on-off cycle by a period with a higher selectivity (i.e., during the bias off).

Claim 1 requires the frequency of the applied bias to be such that the distribution of the plasma's ion energy includes a peak in each of the high energy and low energy regions.

Applicant's figure 5 is a graph profiling the ion energy distributions that are obtained from the application of two different bias frequencies. When a high biasing frequency is applied (e.g. 100 kHz) the graph shows that there are many high energy ions and many low energy ions, that is, the distribution of ion energies is largely bimodal in character. Claim 30 includes a limitation pertaining to the ion energy distribution profile, specifically it requires that the number of ions at a high and low energy value be at least twice the number of ions at an intermediate energy value. Applicant has demonstrated (see figure 4) that this is inherent when a high frequency bias, such as that taught by Gotoh, is applied to the substrate.

Also considered to be inherent is the limitation of claim 1 requiring the peak to peak voltage of the modulated bias power be set to a level such that the etching rate that is obtained with a modulated bias power is equal to the etching rate that is obtained with the continuous application of a smaller peak-to-peak voltage bias power. The examiner maintains that the application of bias power increases the rate of etching and that the rate of etching modulates in conjunction with the modulation of bias power. The bias-off periods correspond to periods with a lower etching rate. Therefore, modulation of the bias power leads to an overall decrease in the rate of etching when compared to a continuous bias etching process. On the other hand, increasing the peak-to-peak voltage of the bias power increases the rate of etching. Therefore, in order to satisfy the limitation of claim 1 which requires the process using a modulated bias power to have the same etch rate that would be obtained by using a continuous bias power, the

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peak-to-peak voltage of the bias power must be increased to compensated for the reduction in etch rate that is brought about by modulating the bias power.

***Response to Arguments***

Applicant's arguments filed June 11, 2003 have been fully considered.

Applicant properly notes that the Examiner failed to address claim 4 in the previous Office action. Unfortunately, Applicant's assumption that examiner considers claim 4 to be allowable is not correct. In actuality, the Examiner's failure to address claim 4 was an oversight, and as a result, this action is not made final. Additional arguments made by Applicant are addressed in the above rejection.

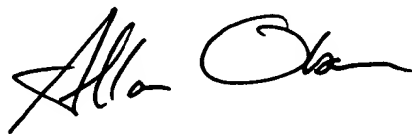
***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 703-306-9075. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Greg Mills, can be reached on 703-308-1633.

The general fax numbers for TC1700 are 703-872-9310 (non-after finals) and 703-872-9311(after-final).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0661.

Allan Olsen, Ph.D.  
August 12, 2003

A handwritten signature in black ink, appearing to read "Allan Olsen", is written over the typed name and date.